

WHAT IS CLAIMED IS:*Sub A1*

1. A semiconductor light-emitting element comprising:
a substrate;
a reflective layer which is formed on said substrate, contains a metal, and reflects light;
a light-emitting layer formed on said reflective layer to emit light; and
a transparent electrode formed on said light-emitting layer to transmit light.

2. An element according to claim 1, wherein said light-emitting layer has a double-heterostructure in which an active layer is sandwiched between first and second cladding layers.

3. An element according to claim 1, further comprising:
an electrode of one conductivity type between a surface of said substrate and said reflective layer;
a contact layer of the one conductivity type between said reflective layer and said light-emitting layer; and
a contact layer of an opposite conductivity type between said light-emitting layer and said transparent electrode.

4. An element according to claim 2, further comprising:
an electrode of one conductivity type between a surface of said substrate and said reflective layer;
a contact layer of the one conductivity type between said reflective layer and said light-emitting layer; and
a contact layer of an opposite conductivity type between said light-emitting layer and said transparent electrode.

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5. An element according to claim 4, further comprising a strain relaxing layer which is sandwiched between said contact layer of one conductivity type and said first cladding layer, and has a middle band gap between band gaps of said contact layer of the one conductivity type and said first cladding layer.

6. An element according to claim 3, wherein said contact layer of the one conductivity type and said contact layer of the opposite conductivity type contain InGaP or InGaAlP.

7. An element according to claim 3, further comprising an intermediate layer between said electrode of the one conductivity type and said reflective layer.

8. An element according to claim 1, wherein said reflective layer has a two-layered structure made up of a transparent conductive film and a metal.

9. An element according to claim 1, wherein said transparent electrode is formed using an ITO (Indium Tin Oxide) film.

10. An element according to claim 1, wherein said substrate contains a metal.

11. An element according to claim 1, wherein compositions of first and second cladding layers are adjusted to set band gaps of said first and second cladding layers to be larger than a band gap of an active layer.

12. An element according to claim 1, wherein an active layer has a single or multiple quantum well structure including a well layer and a barrier layer.

13. A semiconductor light-emitting element comprising:
a transparent semiconductor substrate;
a buffer layer on said semiconductor substrate that lattice-matches said semiconductor substrate;
a light-emitting layer formed on said buffer layer;
a first electrode formed on said buffer layer; and
a second light-reflecting electrode formed on said light-emitting layer.

14. A semiconductor light-emitting element comprising:
a semiconductor substrate;
a light-emitting layer formed on said semiconductor substrate; and
first and second electrodes formed on the same plane,
wherein said semiconductor substrate has a light extraction window so as to pass light emitted by said light-emitting layer.
15. A semiconductor light-emitting element manufacturing method comprising the steps of:
forming a buffer layer on a transparent semiconductor substrate so as to be lattice-matched with the semiconductor substrate;
sequentially forming a first contact layer, a first cladding layer, a light-emitting layer, a second cladding layer, and a second contact layer on the buffer layer;
partially removing the first cladding layer, the light-emitting layer, the second cladding layer, and the second contact layer to expose a surface of the first contact layer;
forming a first electrode on the exposed surface of the first contact layer; and
forming a second light-reflecting electrode on a surface of the second contact layer.
16. A semiconductor light-emitting element manufacturing method comprising the steps of:
sequentially forming a buffer layer, a first contact layer, a first cladding layer, a light-emitting layer, a second cladding layer, and a second contact layer on a semiconductor substrate;
partially removing the first cladding layer, the light-emitting layer, the second cladding layer, and the second contact layer to expose a surface of the first contact layer;
forming a first electrode on the exposed surface of the first contact layer;
forming a second light-reflecting electrode on a surface of the second contact layer; and

forming a light extraction window at a portion of the semiconductor substrate at which the light extraction window faces the second electrode.

sub A3 17. A semiconductor light-emitting element comprising:
 a transparent semiconductor substrate;
 a double-heterostructure which is formed on said semiconductor substrate and contains a light-emitting layer and first and second cladding layers that sandwich two surfaces of the light-emitting layer; and
 a contact layer which is formed on said double-heterostructure and has a recessed surface.

18. A semiconductor light-emitting element manufacturing method comprising the steps of:
 sequentially forming a buffer layer, a first cladding layer, a light-emitting layer, a second cladding layer, and a contact layer on a transparent semiconductor substrate;
 recessing a surface of the contact layer;
 forming a first light-reflecting electrode on the surface of the contact layer; and
 forming a second electrode on a surface of the semiconductor substrate so as to remove a portion at which the second electrode faces the first electrode.

19. A semiconductor light-emitting element manufacturing method comprising the steps of:
 forming a buffer layer on a transparent semiconductor substrate so as to be lattice-matched with the semiconductor substrate;
 sequentially forming a first cladding layer, a light-emitting layer, a second cladding layer, and a contact layer on the buffer layer;
 recessing a surface of the contact layer;
 forming a first light-reflecting electrode on the surface of the contact layer; and
 forming a second electrode on a surface of the

semiconductor substrate.

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20. A semiconductor light-emitting element comprising at least a light-emitting layer formed on a semiconductor substrate, wherein a shape of said semiconductor light-emitting element is a polygonal prism having at least five corners or a circular cylinder.

21. A semiconductor light-emitting element having a light-emitting layer for emitting light in a direction of plane, comprising:

a photonics crystal layer on at least one surface of the light-emitting layer.

22. An element according to claim 21, wherein said photonics crystal layer is formed on the light-emitting layer on a side of a compound semiconductor light-emitting element opposite to a light extraction surface.

23. An element according to claim 21, wherein said photonics crystal layer is formed on the light-emitting layer on a light extraction surface side of the semiconductor light-emitting element, and a through dislocation exists on the light extraction surface in a substantially vertical direction to pass light emitted by the light-emitting layer.

24. A semiconductor light-emitting element comprising:
a semiconductor substrate;
a contact layer formed on said semiconductor substrate;
a first cladding layer formed on said contact layer;
a light-emitting layer formed on said first cladding layer;

and

a second cladding layer formed on said light-emitting layer,

wherein an interface of said contact layer in contact with said first cladding layer is corrugated to have a gradient index, and light emitted by said light-emitting layer is reflected by

the interface.

- Art 45* 25. A semiconductor light-emitting element comprising:
 a semiconductor substrate; and
 a light-emitting layer formed on said semiconductor substrate,
 wherein said semiconductor substrate has a rounded edge.
26. A semiconductor light-emitting element comprising:
 a photonics crystal layer; and
 at least one light-emitting element formed on each of two surfaces of said photonics crystal layer,
 wherein said light-emitting elements emit light with different emission wavelengths.
27. A semiconductor light-emitting element comprising:
 a transparent semiconductor substrate;
 a Bragg reflective layer formed on said semiconductor substrate;
 an active layer formed on said Bragg reflective layer; and
 a photonics crystal layer formed on said active layer.
28. A semiconductor light-emitting element manufacturing method comprising the steps of:
 sequentially forming a buffer layer, a first cladding layer, a light-emitting layer, and a second cladding layer on a first semiconductor substrate;
 forming a photonics crystal layer on the second semiconductor substrate;
 fusing the second cladding layer and the photonics crystal layer; and
 removing the first semiconductor substrate and the buffer layer.
29. A semiconductor light-emitting element manufacturing method comprising the steps of:
 sequentially forming a buffer layer, a contact layer, a

first cladding layer, a light-emitting layer, and a second cladding layer on a first transparent semiconductor substrate;
 forming a photonics crystal layer on a second semiconductor substrate;

fusing the first semiconductor substrate and the photonics crystal layer; and

removing the second semiconductor substrate,

wherein the photonics crystal layer contains a through dislocation on a light extraction surface in a substantially vertical direction to pass light emitted by the light-emitting layer.

30. A semiconductor light-emitting element manufacturing method comprising the steps of:

forming a contact layer on a semiconductor substrate;

corrugating a surface of the contact layer; and

sequentially forming a first cladding layer, a light-emitting layer, and a second cladding layer on the contact layer,

wherein a gradient index is given by the corrugated interface of the contact layer in contact with the first cladding layer, and light emitted by the light-emitting layer is reflected by the interface.

31. A semiconductor light-emitting element manufacturing method comprising the steps of:

forming at least a light-emitting layer on a semiconductor substrate; and

processing an edge of the semiconductor substrate to round the edge.

32. A semiconductor light-emitting element manufacturing method comprising the steps of:

forming a buffer layer on a first transparent semiconductor substrate;

forming a Bragg reflective layer on the buffer layer;

sequentially forming a light-emitting layer, a cladding

layer, and a bonding layer on the Bragg reflective layer;
forming a photonics crystal layer on a second semiconductor substrate;

bonding the cladding layer and the photonics crystal layer via the bonding layer; and

removing the second semiconductor substrate.